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SOIL MOISTURE CONTENT DURING CRITICAL PERIODS IN THE REGENERATION OF PREVIOUSLY GRAZED FARM WOODLANDS*

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One of the most interesting observations resulting from studies of the regeneration of farm woods following continued overgrazing has been the apparent static condition of certain areas over long periods. These studies, cooperatively made by the Central States Forest Experiment Station and the Purdue University Agricultural Experiment Station (4), indicate that many woodlands which had deteriorated to the point where a complete sod cover had become established were incapable of natural recovery within a reasonable length of time. In these open areas, whenever the proper coincidence of seed crops and conditions favorable for germination occurred, tree seedlings gained a start in the spring, but during the dry summer a very high mortality often took place, and by the following season the seedlings had usually disappeared from the area.

These preliminary observations were followed up by supplementary intensive ecological studies which were carried on in a number of northern Indiana farm woods. The conclusion reached following three seasons of observations and periodic measurements (5) was that soil moisture is the principal limiting factor in the satisfactory regeneration of these grazed woodlands which have reached the advanced stages of decadence. Woodlands in which a complete sod cover has been established through the partial opening up of the stand probably suffer a greater loss of soil moisture than woodlands in any other stage in the transition from dense forest to open pasture. This has been attributed to the cumulative effect of increased transpiration and evaporation in these "open park" woods. The factors which tend to conserve moisture have been materially disturbed through the compacting of the soil surface (1), the disappearance of the protective forest litter, the elimination of the shrubby undergrowth and tree seedlings which served as an effective barrier against free wind movements, and the formation of a sod cover. On the other hand, the tremendous amount of transpiration which takes place in the dense forest has been only moderately lowered through the reduction in the number of trees.

Important problems in the management of these areas obviously hinge on the soundness of this hypothesis, and in order to secure definite quantitative data a series of soil-moisture determinations were made by the writer, with the assistance of Mace Raymond, of the Purdue Agricultural Experiment Station, during the summer of 1935. These studies were made in the oak-hickory type on a Miami silty clay loam in Grant County, Ind. Soil moisture determinations were made weekly in the A, B, and C horizons of an open grazed woods, and also in an adjacent fully stocked woods and an open pasture.

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ificant in the chart. That is that the soil-moisture content in the A and B horizons in the open field was in practically every case higher than in either of the other two habitats. From these data, which were obtained during the growing season only, it would appear that the benefits of decreased run-off and evaporation (8) and increased water-holding capacity of the soil under a forest cover (1) are partially or entirely outweighed, so far as available moisture in the upper horizons is concerned, during the summer months by the tremendous amount of transpiration which takes place in the forest. According to Craib (3), Ebermayer has shown that forested areas of pine and beech contained considerably less soil moisture than open areas during all four seasons of the year. Zon (10) also points out that in level country forests tend to lower the water table and reduce the soil moisture to a greater degree than other forms of vegetation. Bates (2) has recently published data obtained from lysimeters which demonstrated that the real period of ground-water replenishment is in the winter and spring. From July to December, the lysimeters did not yield a drop of water despite a total rainfall of 18.18 inches. The apparent counter trend in the C horizon, where the moisture content is in two instances higher in the ungrazed woodland, is quite possibly due to greater water storage in the lower horizons during the dormant season. Since soil seldom freezes under forest litter and forest soil is much more porous, it is reasonable to believe that percolation occurs to a greater depth than in open areas, where no percolation is possible while the ground is frozen. Since it is generally believed that the upper horizons supply most of the water requirements of trees and that lateral movements of soil moisture in level country occur at a very slow rate, it would appear that this concentration at the lower depths might be rather stable throughout the season.

It is fully appreciated that the results of this study, covering only one season of observations, are inconclusive, but they have served to establish a rather definite relationship between the very critical soil-moisture conditions which exist in the open grazed woodlands during the mid-summer drouth periods and the repeated failure of natural regeneration in many of these areas. Further quantitative data are needed to determine the influence of forest cover on ground-water supplies in the Corn Belt region.

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Fig. 1.--Soil-moisture conditions in a fully stocked oak-hickory woodland, open grazed woodland, and blue-grass pasture. McVicker farm, Upland, Ind., summer of 1935